Sparkær Blade Test Centre
RISØ National Laboratory, Denmark

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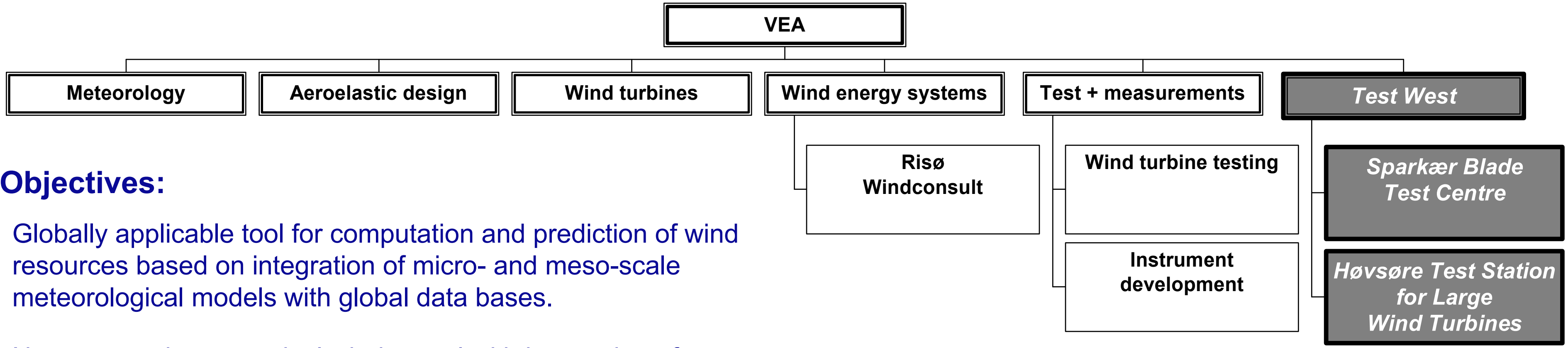
Risø National Laboratory, Denmark

A national laboratory under the ministry for Science technology and innovation

Wind Energy Department VEA organization 2004



Objectives:

Globally applicable tool for computation and prediction of wind resources based on integration of micro- and meso-scale meteorological models with global data bases.

Next-generation numerical wind tunnel with integration of computation of fluid dynamics (CFD), structure- and system dynamic models for design of wind turbines and for interpretation of test data using scientific computing.

Design basis for multi-MW offshore wind turbines based on a complete statistical description of climatic conditions, especially wind, waves and ice.

Testing facilities and testing methods for MW wind turbines and wind turbine components.

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About 120 employed

Academic staff	80
Technical/administrative staff	30
PhD and postdocs	10

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Høvsøre Test Station for Large Wind Turbines

Sparkær Blade Test Centre - location

RISØ National Laboratory

Høvsøre Test Station for Large Wind Turbines

Sparkær Blade Test Centre – in brief

15 employees:
1 manager
6 test engineers
1 supervisor
6 technicians
1 secretary

Tasks:

•Wind turbine blade testing

•Operation of Høvsøre Test Station for Large Wind turbines

•Wind Turbines Measurements

Sparkær Blade Test Centre - tests

Accredited tests:

- Determination of natural frequencies
    - Modal analysis
    - Manual excitation
- Static blade test
- Fatigue blade test

DANAK

Reg. no. 427

Not accredited tests:

- Stiffness test
- Calibration of Strain Gauges

Normative references:

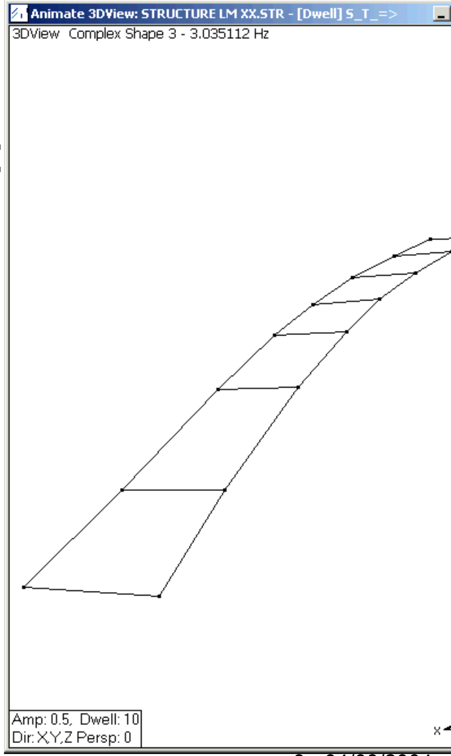
Recommendation for fulfilling requirements in "Technical Criteria"
Danish Energy Agency, 1st July 1992

Recommendation for Design and Test of Wind Turbine Blades
1st edition, Danish Energy Agency, November 2002

IEC TS 61400-23, Full-scale structural testing of rotor blades
1st edition, 2001-04

Determination of natural frequencies

- 2 methods:
  - Manual excitation:
    - 1. 2. mode flapwise: frequency & damping
    - 1. mode edgewise: frequency & damping
    - 1. mode torsional: frequency
  - Modal analysis using Brüel & Kjaer Pulse equipment:
    - 1. 2. 3. and 4. mode flapwise: frequency & damping
    - 1. 2. mode edgewise: frequency & damping
    - 1. mode torsional: frequency & damping
    - Mode shapes of the blade

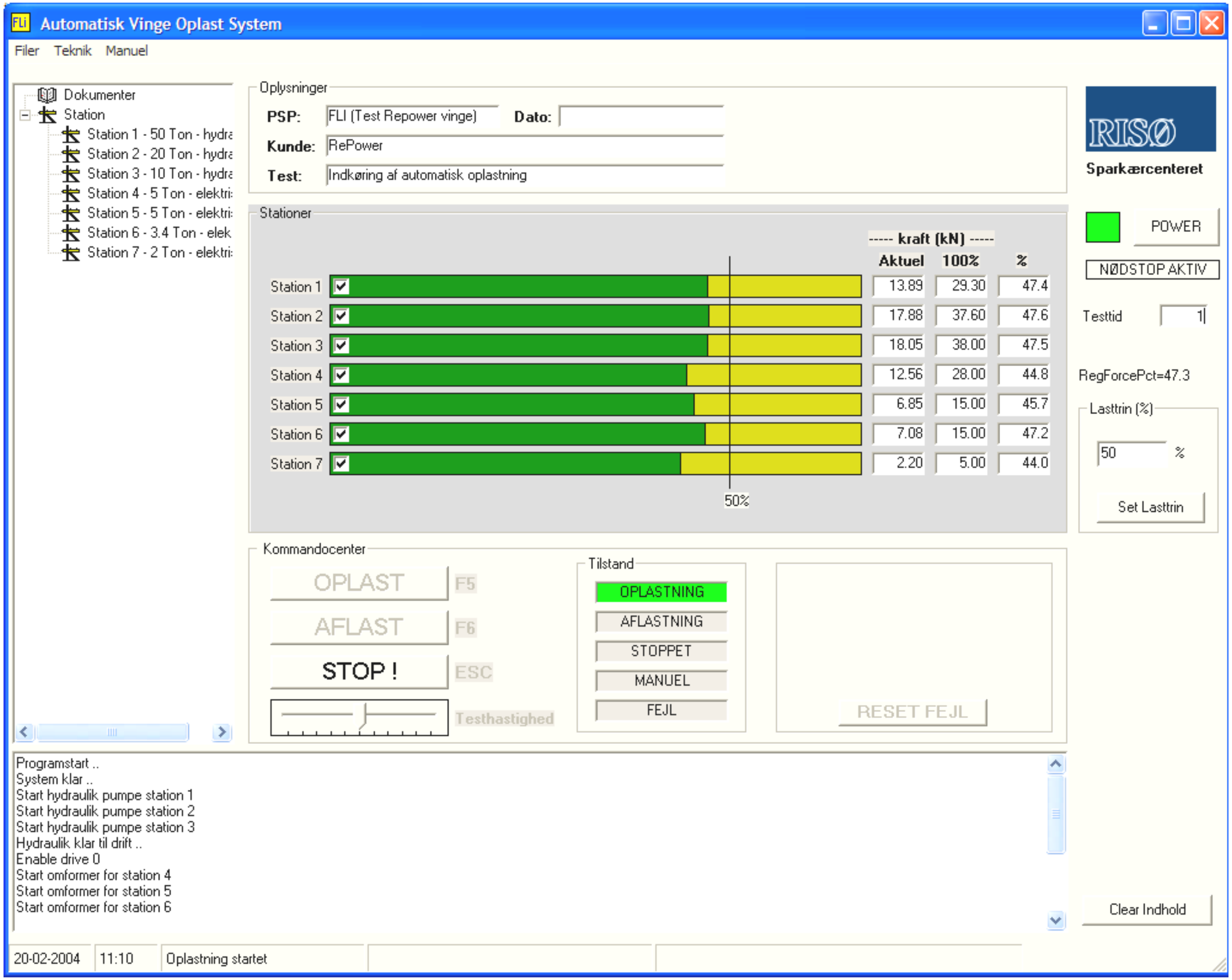


Static testing – blade under flapwise test

Static testing - capacity

- 7 pull stations:
  - 25 - 32 – 50 – 50 – 100 – 200 – 500 kN capacity
  - automatic load control
- Data acquisition:
  - Data is sampled once per second on
    - 96 strain gauge channels and
    - 32 analogue channels – i.e. distance transducers and load cells
  - Online graphs of actual values of strain vs. local bending moment
- Video surveillance / recording

Automatic load control - screenshot



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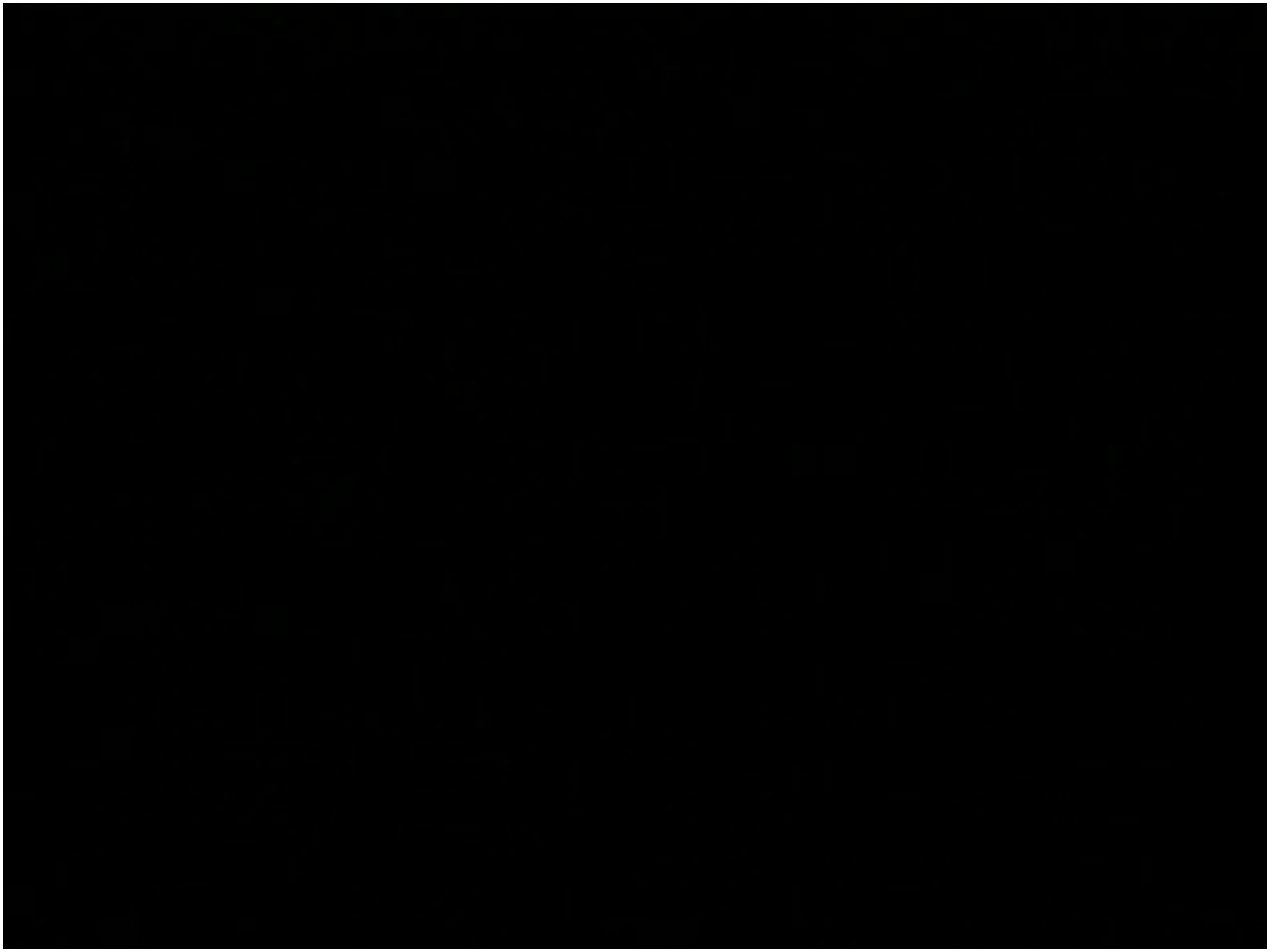
Fatigue testing – 3 blades in flapwise test



Fatigue testing

- Resonance method – exciter with rotating eccentric mass
- Automatic control of the load level
- Blade calibrations and inspections at regular intervals
- Monitoring the local stiffness and strain throughout the test

Full scale blade tests – why?

- Because present calculation methods is not sufficiently accurate to take the complex structure of a modern blade into account

- Because the blade is designed by an assumption of the production methods are under control

- Because a full scale test of the blade is required by the Certifying Bodies in connection with certification of the Wind Turbine

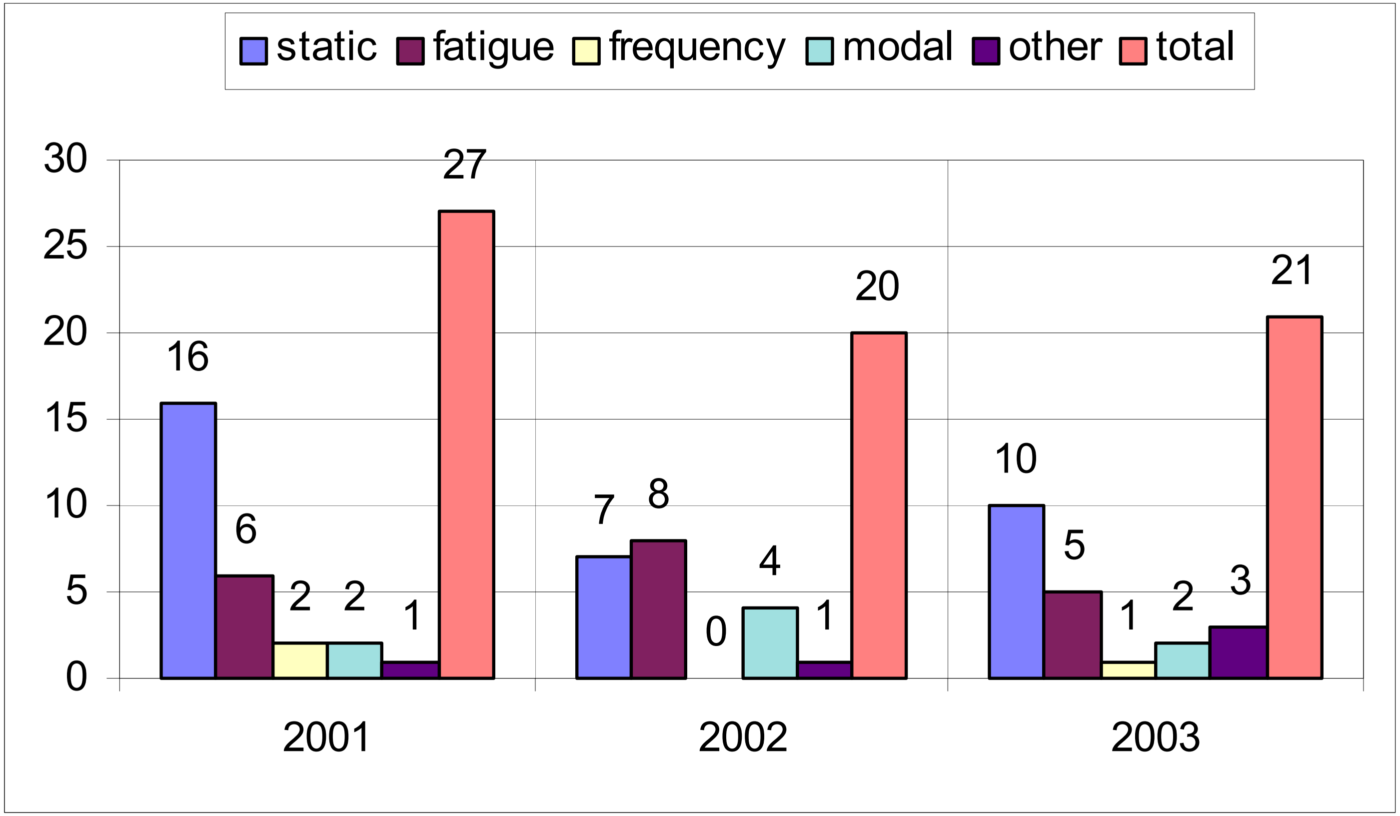
Advantages of full scale blade tests

- Failures from both design and production are exposed and can be examined
- Experiences from collapses and critical failures can be utilized when introducing new materials or production methods
- Cracks in glued joints and in load carrying laminates are easily observed at for example fatigue tests
- Determine the reason for failures, -production errors or design assumptions, reducing future maintenance costs

Why offered by the Wind Energy Department?

- Because VEA needs to maintain and develop our network in the Wind Energy sector
- Because we want to improve our competence and target our research

Annual throughput of blade tests



Test rigs in operation

Test rig	Max. blade length [m]	Max. static moment [kNm]	Max. fatigue moment range [kNm]
A	52	20.000	10.000
B	53	10.000	8.000
C	53	6.000	5.000
D	34	3.000	1.000
F	14	3.000	1.000

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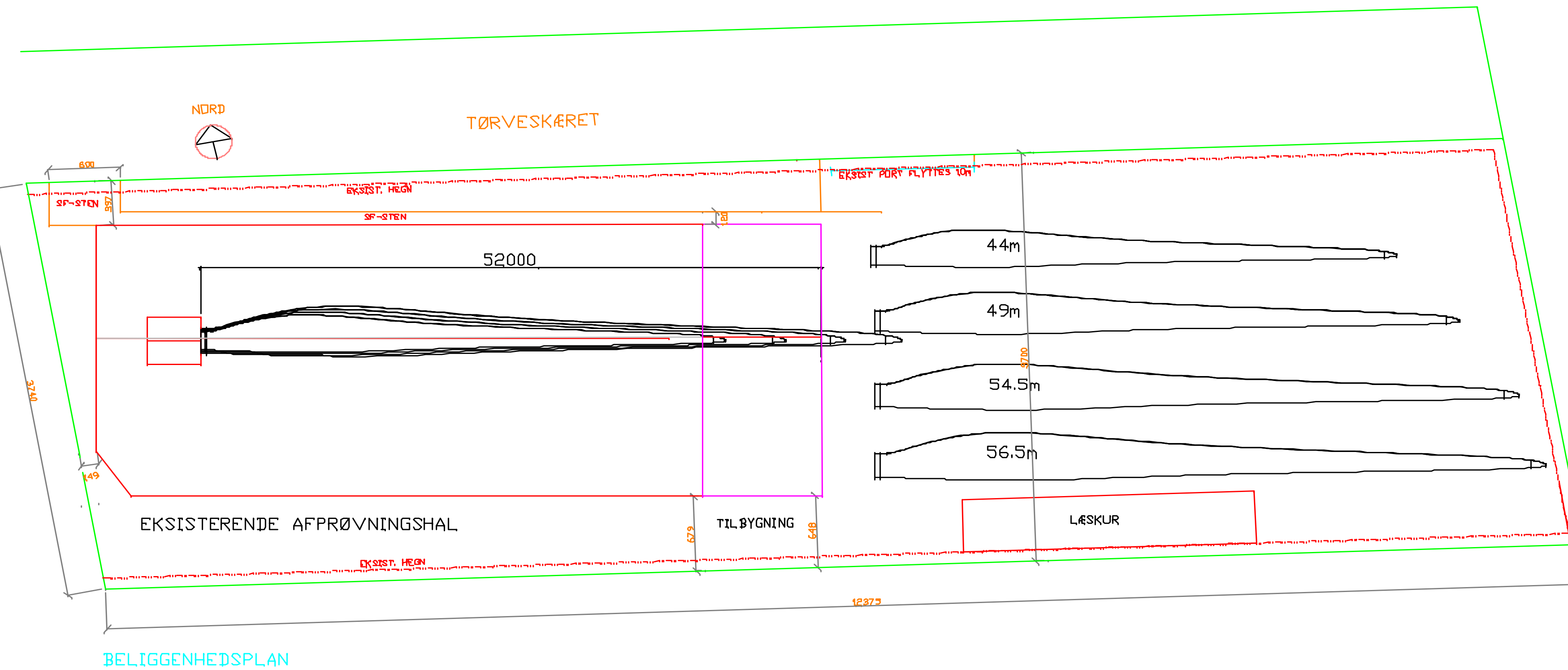
Plan view of the test hall with test rig A



Forthcoming challenges for the testing facility

- New facility for tests of 80m blades, - with a potential to extent to 100m blades
- Static test capacity up to 140,000 kNm
- Facility located near highway and harbour and the present staff at Sparkær
- Test Centre will formed as a limited company with Risø and other investors as shareholders
- Time frame within this year

Forthcoming challenges regarding new or improved test methods

- Introduce:
  - Acoustic emission detection equipment for early detection of damages occurring at static tests
  - Monitoring of local deformations (buckling) during static tests
  - Systematic thermo graphic inspections of blades undergoing fatigue tests
  - Systematic scanning with ultra-sonic equipment
- Improve:
  - Fatigue test load tolerances, both spanwise mean load and load range as more sensitive materials are introduced in blade production

Sparkær Blade Test Centre - locations

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Thank You.